

***Striatodoma dorothea* (Cheilostomatida: Tessaradomidae), a new genus and species of bryozoan from deep water off California**

Judith E. Winston and Stace E. Beaulieu

(JEW) Virginia Museum of Natural History, Martinsville, Virginia 24112, U.S.A.;

(SEB) Marine Biology Research Division, Scripps Institution of Oceanography,
La Jolla, California 92093-0202, U.S.A.

(Current address) Applied Ocean Physics and Engineering Department,
Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543, U.S.A.

Abstract—*Striatodoma dorothea*, a new genus and species of cheilostomate bryozoan, is described from material found attached to hexactinellid sponges and pogonophoran tubes at an abyssal station (4100 m depth) off central California. Members of this new genus can be distinguished from other members of the family Tessaradomidae by the presence of biserial, rather than quadriserial branches, and a peristomial sinus, rather than an enclosed spiramen. Two other Pacific species, *Diplonotos striatum* Canu & Bassler, 1930, and *Tessaradoma bifax* Cheetham, 1972, are transferred to *Striatodoma*.

Although bryozoans have been identified from deep-sea stations down to 8300 m, reviews by Schopf (1969) and Hayward (1981) have shown that only a tiny portion of the deep ocean floor has been sampled for the group. Nothing is known of the deep-sea bryozoan fauna of the eastern Pacific with the exception of three species found at two stations in the eastern Pacific between Acapulco and Panama during the *Galathea* Expedition (Hayward 1981). Recently, as part of a study by Beaulieu (1998) of hard substrate epifauna at abyssal depths off California, an attempt was made to identify all taxa attached to biogenic structures that protruded from the soft sediment of the sea floor. Individual stalks of the hexactinellid sponge *Hyalonema* sp. and individual tubes of the pogonophoran *Unibrachium* sp. were sampled in tube cores using the submersible *Alvin* at 4100 m depth. Two of the approximately 140 species found attached to the sponge stalks and pogonophoran tubes were bryozoans. One is a ctenostome, *Arachnidium hippothoides* Hincks, 1862. The other is an undescribed genus and species of deep-sea chei-

lostome which we name and describe below.

Tessaradomidae Jullien, 1903
Striatodoma, new genus

Diagnosis.—Tessaradomidae characterized by subcylindrical, proximally thickened branches with two series of zooids, longitudinally striated calcification, a spiramen in close association with zooid peristome, rows of marginal pores, some of them replaced by oval avicularia, and a subglobular imperforate ovicell. *Striatodoma* differs from *Tessaradoma* in possessing branches made up of two, rather than four series of zooids, and in confluence of the spiramen with a peristomial sinus.

Type species.—*Striatodoma dorothea*, new species, by present designation.

Additional species of Striatodoma.—*Tessaradoma bifax* Cheetham, 1972 and *Diplonotos striatum* Canu & Bassler, 1930.

Etymology.—The first part of the genus name is from the Latin, *striatus* = furrowed, channeled, descriptive of the striated appearance of colony walls. The second

part, *doma*, is derived from the Greek δωμα, δωματοζ, house, roof, to parallel the other genus name in the family, *Tessaradoma*. Gender neuter.

Remarks.—During the last hundred years seven living and fossil species of deep water cheilostomes have been described and placed in the family Tessaradomidae Jullien, 1903, and genus *Tessaradoma* Norman 1869, type species *Onchopora borealis* Busk, 1860. Jullien defined the family as having erect or encrusting colonies and zooids, a tubular peristome with a tubuliform spiramen opening into its base, and with a small, spherical, imperforate ovicell, also opening into the peristome above the zooidal operculum. The genus *Tessaradoma* has a colony form consisting of erect, unjointed cylindrical branches arising from an encrusting base, zooids with a projecting peristome and prominent spiramen, imperforate ovicells obscured by increasing calcification, and adventitious avicularia (Hayward & Ryland 1979). The type species, *Tessaradoma boreale*, has a Recent distribution in both the North and South Atlantic and is also known from Neogene fossil localities in western Europe and the Mediterranean (Cheetham 1972, Lagaaij & Cook 1973). Its colonies are erect, rigid, and spreading, with quadriserial branches consisting of elongate oval zooids, arranged back to back in alternating pairs. The zooid primary orifice is concealed by a tubular peristome with a spiramen tube near its base, its opening projecting from the zooid frontal surface about one third of the way down the frontal wall. Wall calcification is granular, becoming striated around the conspicuous marginal pores. Oval adventitious avicularia are also developed in the margins, particularly lateral to the spiramen. The ovicell is small, smooth, imperforate, subspherical (slightly broader than long), and though conspicuous in young zooids becomes increasingly immersed in calcification as zooids age (Hayward & Ryland 1979).

Hayward (1981) described *Tessaradoma*

brevissima from the Tasman Sea, but Gordon (1989), who recorded *T. brevissima* from additional deep water localities off New Zealand, placed the species in the genus *Galeopsis* (family Celleporidae) on the basis of the following characters: paired avicularia in close association with peristome and sinus, and an ovicell with a central tabulate or fenestrate area and labellum. Two South African species, *Tessaradoma bispiramina* and *Tessaradoma circella*, described by Hayward & Cook (1979), and the Indonesian species *Tessaradoma bipatens*, described by Harmer (1957) also seem to belong in this group.

In contrast, the new Pacific species described below, as well as two other Pacific species, the Eocene *Tessaradoma bifax* from the small western Pacific Island of Tonga (Cheetham 1972), and the Recent *Tessaradoma striatum* from the Galapagos (Canu & Bassler 1930), differ from them in the furrowed appearance of frontal wall calcification, the subspherical imperforate ovicell and the association of the spiramen with the peristomial sinus. These Pacific species appear to be related to *Tessaradoma*, but their shared features indicate they should be grouped with the new species described below in a new genus, *Striatodoma*. The Eocene *Tessaradoma bifax* described by Cheetham (1972) from Tonga, is very similar in morphology to *Striatodoma dorothea*, with biserial branches, tubular peristome, and with lateral pores and avicularia making a sinuate double trail along the sides of branches. In this species, however, the sinus (at least in the fragmentary material available) does not become calcified into a tube. In addition, its ovicell is not as prominent as that of *S. dorothea*, appearing only as a slight enlargement of the peristome of the maternal zooid, and a swelling of the frontal shield of the distal zooid. The Recent *Diplonotos striatum* collected from the Galapagos at 1251 m depth (Canu & Bassler 1930) also belongs in this group. Based on his studies of syntype material, Cheetham (1972) transferred that species to

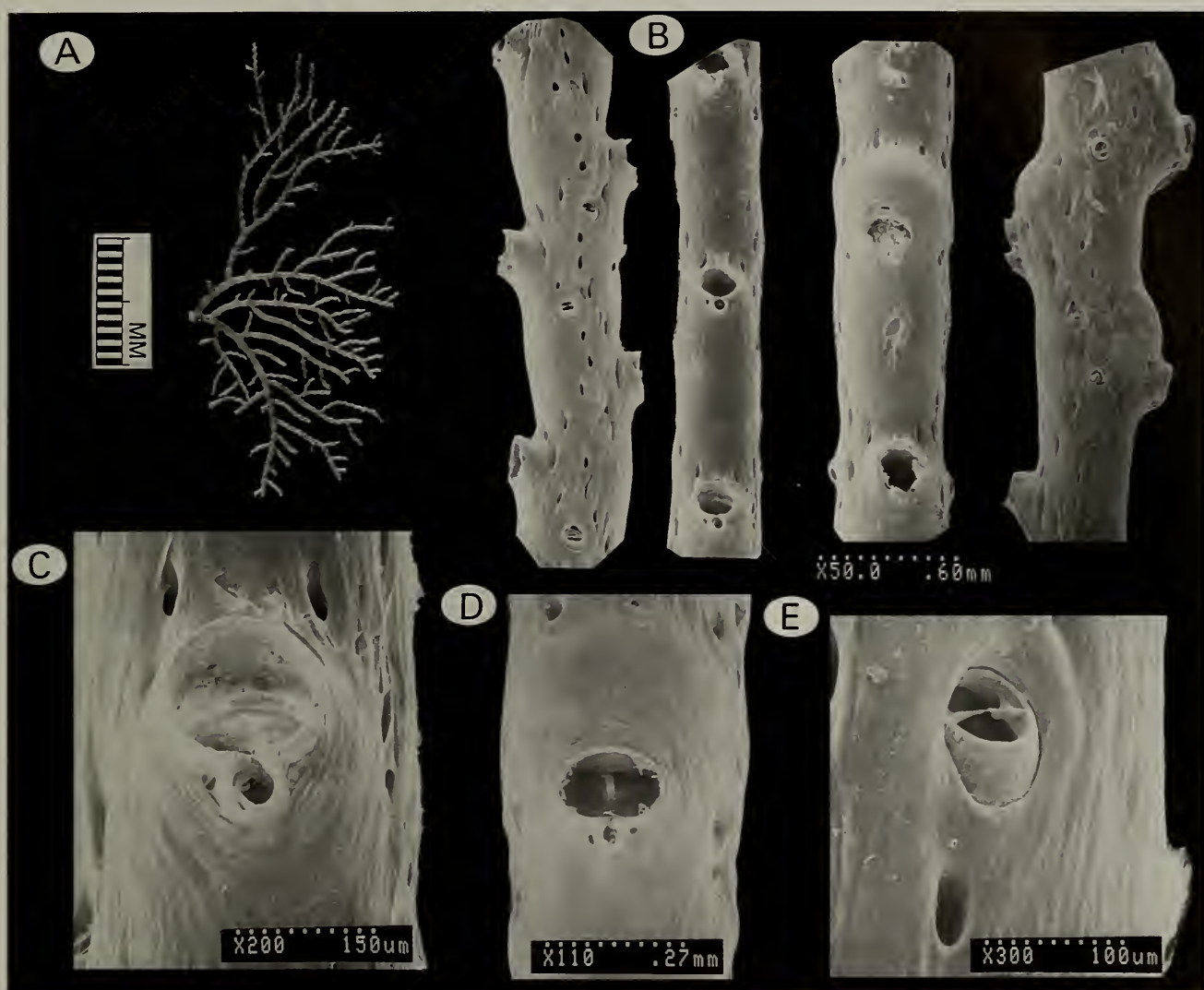


Fig. 1. *Striatodoma dorothea* new species. All illustrations from portions of holotype colony. CASIZ 113579, attached to pogonophoran tube collected 4100 m depth on *Alvin* Dive 2828 at 34°42'N, 123°00'W, off California. (A) Largest colony fragment showing colony form and branching pattern [scale = 2 cm]. (B) Zooid morphology [from left to right] autozooids in side and front view; ovicelled zooids in front and side view [scale bar = 0.6 mm]. (C) Closeup of peristome, showing spiramen sinus [scale bar = 150 μ m]. (D) Closeup of mature ovicelled zooids, showing constricted peristome and completely enclosed sinus [scale bar = 0.270 mm]. (E) Closeup of lateral avicularium, showing diagonally tilted rostrum and calcified pivotal hinges [scale bar = 100 μ m].

Tessaradoma on the basis of its similarity to *T. bifax*, remarking that, contrary to Canu and Bassler's original description, the primary orifice does lie at the base of a peristomial shaft, but that shaft is almost completely immersed in the thickened frontal shield. Its chief difference from the other two species lies in the extreme development of frontal wall calcification, in which striation becomes rugosity and external zooid boundaries are lost. The positions of lateral avicularia and pores may still be faintly discerned, however, and match the pattern in the other two species. Like *S. dorothea*, the

sinus in *S. striatum* may become completely enclosed to form a tube.

Striatodoma dorothea new species
Fig. 1

Holotype.—California Academy of Sciences, CASIZ 113579, attached to pogonophoran tube collected as stalk no. 3 (Beaulieu 1998) at 34°42'N, 123°00'W, 4100 m depth, 17 Sep 1994.

Paratypes.—Virginia Museum of Natural History 567; from stalk 4, ~4100 m, PULSE 22 Cruise, Chief Scientist Kenneth

Table 1.—Measurements (in mm) of holotype and paratype specimens of *Striatodoma dorothea*.

Character	Range	Mean	SD	n
Zooid Length	0.364–0.501	0.444	0.038	12
Zooid Width	0.191–0.273	0.231	0.027	12
Orifice Length (autozooid)	0.073–0.100	0.085	0.009	12
Orifice Width (autozooid)	0.091–0.109	0.102	0.008	12
Orifice Length (ovicelled zooid)	0.073	—	—	2
Orifice Width (ovicelled zooid)	0.100	—	—	2
Ovicell Length	0.109–0.155	0.134	0.016	6
Ovicell Width	0.182–0.210	0.196	0.011	6
Avicularia Length	0.036–0.055	0.044	0.007	11
Avicularia Width	0.027–0.046	0.036	0.004	11
Branch Width (Distal end)	0.291–0.337	0.301	0.025	12
Branch Width (Basal end)	0.364–0.728	0.558	0.103	9

L. Smith, Jr., Scripps Institution of Oceanography, Alvin Dive 2828, 17 Sep 1994. Water temperature 1.2°C, 34°42'N, 123°00'W; CASIZ 113580, stalk 37, 34°56'N, 123°07'W, 4100 m, PULSE 24 FVGR, 16 Feb 1995; CASIZ 113581, stalk 33, 34°42'N, 123°00'W, 4100 m, PULSE 25, Dive 2920, 30 Apr 1995; CASIZ 113582, stalk 12, 34°42'N, 123°00'W, 4100 m, PULSE 22, Dive 2834, 23 Sep 1994; collector for all, Stace Beaulieu.

Etymology.—*dorothea*, the Latinized spelling of Dorothy, used as a noun in apposition. The species is named in honor of Dorothy F. Soule, in recognition of her elegant studies of Pacific bryozoans and of her active stewardship of California marine environments.

Diagnosis.—Characterized by subcylindrical branches made up of two series of rectangular zooids, with longitudinally striated calcification, rows of marginal pores, with occasional pores replaced by oval avicularia, short peristome with spiramen enclosed in proximal peristomial sinus, and relatively prominent ovicell.

Description.—Colony erect, rigidly calcified, unjointed, broadly branching in a planar fashion, up to several cm in size, the two biggest branch fragments of the largest specimen found (the holotype), measuring 3 cm h × 7 cm w and 5 cm h × 5 cm w, respectively (Fig. 1A). Attached to stalks of deep water glass sponges and pogonopho-

ran tubes by an encrusting base. Zooids elongate, rectangular, growing back to back in two alternating longitudinal series (Fig. 1B). Frontal wall convex, with faint longitudinal striations, most of its surface imperforate, but with a row of small oval pores just inside zooid lateral margins. Primary orifice transversely oval, surrounded by a short peristome (Fig. 1C). No outwardly visible spiramen; instead, the peristome of young zooids has a proximal sinus, which is encircled by calcification as the zooid ages, becoming increasingly tubular and projecting. Ovicells are smoothly calcified and globular, reaching the height of the peristome opening, which becomes slightly narrowed in fertile zooids (Fig. 1D). About one pore per zooid is replaced by an oval adventitious avicularium, about 50 μm in length. In side view the sinuate double track of pores and avicularia is distinctive (Fig. 1E, B). In basal regions of the colony zooid openings are calcified over and branches become thickened. Some of the avicularia and pores are calcified over also. Branch thickness (the depth of two back to back zooids) averages 0.301 mm in zooids near the growing edge of branches and 0.558 mm in zooids near the colony base. Zooid measurements are summarized in Table 1.

Distribution and ecology.—The species was observed and/or collected at 4060–4100 m depths off California, between lat-

itudes 34°38' and 34°56'N and longitudes 122°59' and 123°15'W. General area: 220 km west of Point Conception, CA. Beaulieu (1998) collected a total of 35 tube core samples at the abyssal station and found seven colonies of *S. dorothea* (one colony per substrate; Table 2). The species was attached to pogonophoran tubes, the basal spicules of *Hyalonema* sp., and to other organisms that were attached to the host substrate. The branches of *S. dorothea* also provided substrate on which other species attached (Table 2).

In order to determine the abundance of *S. dorothea* at the abyssal station, all colonies large enough to identify with certainty were enumerated in photographic transects of the sea floor (procedures described in Beaulieu 1998). We photographed approximately 9 km of the sea floor (total of seven transects) in which we encountered 55 colonies of *S. dorothea*. Of these, 53 were attached to dead *Hyalonema* spicules, one to a pogonophoran tube, and one to an unidentified structure. The encrusting bases of most of the colonies were attached at the middle of the host substrate, elevating the colonies about 10 cm above the sea floor. Density estimates (no. colonies per unit area of sea floor) were calculated using the computer program DISTANCE (Laake et al. 1994). Mean density estimates for the individual transects ranged between 3 and 8 colonies per 1000 m². Only about 2% of the biogenic structures enumerated in photographic transects appeared to be colonized by *S. dorothea*. However, 20% of the structures collected from the sea floor had *S. dorothea* attached; therefore, the density estimates from the photographic transects may be an order of magnitude low.

Discussion.—Tessaradomids belong to the fauna of the outer continental shelf and slope. The 4100 m depth recorded for *S. dorothea* in this study is the deepest recorded, but it is not much deeper than the 3700 m recorded for *T. boreale*. However, *T. boreale* is found in much shallower water in the Arctic (70 m depth), and Cheet-

Table 2.—Ecological information for *Siriatodoma dorothea* collected in tube cores.

Colony no.	Host substrate	Attached to:	Epizoites attached to <i>S. dorothea</i>
1 ^a	Pogonophoran	Pogonophoran and terebellid (<i>Thelepus</i> sp.) tubes	Agglutinated foraminifera, calcareous foraminiferan (<i>Cibicides lobatulus</i>), colonial hydroid, sabellid, serpulids (<i>Bathyyermilia</i> sp. and <i>Hyalopomatus mironovi</i>), isopod (<i>Arcturus</i> sp.)
2	Pogonophoran	Pogonophoran tube	Agglutinated foraminiferan, calcareous foraminiferan (<i>Cibicides lobatulus</i>), colonial hydroid, serpulid (<i>Hyalopomatus mironovi</i>)
3	<i>Hyalonema</i>	n.d.	Overgrown by colonial hydroid
4	<i>Hyalonema</i>	n.d.	None
5	<i>Hyalonema</i>	<i>Hyalonema</i> spicules	Overgrown by colonial hydroid
6	<i>Hyalonema</i>	Serpulid (<i>Bathyyermilia</i> sp.) tube	None
7	<i>Hyalonema</i>	<i>Hyalonema</i> spicules	None

^a Holotype specimen. n.d. not determined.

ham (1972) suggested that distribution of such deep-sea species may be temperature controlled, limited to water temperatures between 2° and 13° C. This paper and Beaulieu (1998) provide a glimpse of how erect bryozoans with an attached base may survive on the muddy deep sea floor. But as yet, these species are known only from a few broken fragments, collected at widely scattered localities by various expeditions. Better understanding of their ecology as well as clarification of their relationships with shallow water species must await the kinds of collections that can provide material adequate for the detailed anatomic study necessary for phylogenetic analysis.

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